CLAIMS

1. A method for detecting incidents along a roadway comprising the unordered steps of:

arranging a plurality of readers at intervals along a roadway for reading uniquely identified data from each of a plurality of vehicles;

correlating the data with previously read data to obtain information on each of the plurality of vehicles;

determining the number of vehicles potentially affected by incidents along the roadway; and

comparing the number of vehicles potentially affected by incidents to a sample threshold.

2. The method of claim 1, wherein the plurality of readers comprises a plurality of traffic probe readers.

3. The method of claim 1, wherein each of the plurality of readers is spaced at least five kilometers from an adjacent reader.

4. The method of claim 1, wherein the information is at least one of:

a vehicle speed;

an expected vehicle travel time between two adjacent readers; and

an expected arrival time of each of the plurality of vehicles at one of the plurality of readers.

5. The method of claim 1, wherein the step of determining the number of vehicles potentially affected by an incident further comprises the step of determining the expected time for each of the plurality of vehicles to be detected by a particular one of the plurality of readers.

6. The method of claim 5, wherein the step of determining the number of vehicles

potentially affected by an incident further comprises the steps of:

determining the amount of time each vehicle time is overdue past the expected detection time; and

comparing an amount of time each vehicle time is overdue to a predetermined threshold.

7. The method of claim 6, wherein the predetermined threshold is adjusted according to the roadway usage.

8. The method of claim 5, wherein the step of determining the number of each of the plurality of vehicles potentially affected by an incident further comprises the steps of:

determining the amount of time each vehicle time is earlier than the expected detection time; and

comparing an amount of time each vehicle time arrived early to a predetermined threshold.

9. The method of claim 8, wherein the predetermined threshold is adjusted according to the roadway usage.

10. The method of claim 1, further comprising detecting an incident in response to the number of each of the plurality of vehicles potentially affected by an incident exceeding the predetermined sample threshold.

11. The method of claim 10, wherein each of the plurality of vehicles potentially affected by an incident is overdue at one of the plurality of readers.

12. The method of claim 10, wherein each of the plurality of vehicles potentially affected by an incident has arrived early at one of the plurality of readers.

13. The method of claim 12, wherein the number of each of the plurality of vehicles potentially affected by an incident is counted over a predetermined interval.

14. The method of claim 4, wherein the arrival time of expected readings is a function of the vehicle type.

15. The method of claim 1, wherein the plurality of readers comprises a transponder reader.

16. The method of claim 1, wherein the plurality of readers comprises a license plate reader.

17. The method of claim 1 wherein an instantaneous speed of each of the plurality of vehicles is determined by a Toll Gateway sensor.

18. The method of claim 6, wherein the expected time for each of the plurality of vehicles to be detected by reader is calculated by:

$$ExpSpeed[V_i, S_j] = \min(StartSpeed[V_i, S_j], HighSpeed[S_j])$$

$$ExpTime[V_i, S_j] = \frac{Length[S_j]}{ExpSpeed[V_i, S_j]}$$

where,

V_i is a vehicle entering a road segment S_j;

$ExpTime[V_j,S_j]$ = expected time forV_i to be detected;

$StartSpeed[Vj,Sj]$ = starting speed of V_i at the beginning of segment S_j;

$ExpSpeed[V_i,S_j]$ = expected speed over segment S_j;

$HighSpeed$ $[S_j]$ = average legal speed limit over the segment starting at S_j; and

$Length$ $[S_j]$ = length of the segment starting at S_j.

19. The method of claim 18, wherein an overdue time for each of the plurality of vehicles that has not been detected by the expected reader within the expected time, is calculated by:

$$Overdue[V_i, S_j, t_c] = \frac{t_c - StartTime[V_i, S_j] - ExpTime[V_i, S_j]}{ExpTime[V_i, S_j]} \times 100\%$$

where,

$StartTime[V_i, S_j]$ = time that V_i entered the segment starting at S_j.

20. The method of claim 18, wherein a difference between the expected and actual link travel time for each of the plurality of vehicles is calculated by:

$$Diff[V_i, S_j] = \frac{\max\left(ActualTime[V_i, S_j], \frac{Length[S_j]}{HighSpeed[S_j]}\right) - ExpTime[V_i, S_j]}{ExpTime[V_i, S_j]} \times 100\%$$

where:

$ActualTime[Vj,Sj]$ = actual time for V_i to travel over segment S_j.

21. The method of claim 18, wherein the starting speed of V_i is calculated by:

$StartSpeed[Vj,Sj]$ = average speed of V_i over a prior segment.

22. The method of claim 18, wherein the starting speed of V_i is calculated by:

$StartSpeed[V_j,S_j]$ = instantaneous speed of V_i at the start of S_j measured by a toll gateway speed sensor.

23. The method of claim 1, further comprising the step of declaring an incident in response to the number of each of the plurality of vehicles potentially affected by incidents being greater than the sample threshold.

24. The method of claim 1, further comprising the step of excluding each vehicle, that is overdue for more than a predetermined cutoff threshold measured from the time that the vehicle is initially overdue, from being counted in the number of each of the plurality of vehicles potentially affected by incidents.

25. The method of claim 1, further comprising the step of excluding each vehicle, that has arrived early at the end of a roadway segment for more than a predetermined cutoff threshold measured from the time that the vehicle is initially early, from being counted in the number of each of the plurality of vehicles potentially affected by incidents.

26. The method of claim 1, further comprising the step of suppressing the detection of an incident in a roadway segment where the number of vehicles exiting the segment of the roadway on an off-ramp over a predetermined interval of time exceeds a predetermined threshold.

27. A method for detecting incidents along a roadway comprising the unordered steps of:

arranging a plurality of traffic probe readers at intervals along a roadway for reading a transponder disposed on a vehicle;

correlating the transponder readings from each of the plurality of vehicles and expected readings from each of the plurality of vehicles at more than one traffic probe reader; and

detecting incidents which result in an interruption to the flow of traffic.

28. The method of claim 27, further comprising the step of writing time and location data into the transponder of each of the plurality of vehicles.

29. The method of claim 27, further comprising the step of arranging a plurality of toll gateways at intervals along a roadway for reading a transponder ID disposed on each of a plurality of vehicles and for determining the presence of vehicles not having a transponder ID.

30. An incident detection system comprising:

a traffic management center processor connected to a data network;

a plurality of unique vehicle data readers connected to said data network such that uniquely identified data are read from each of a plurality of vehicles;

a correlation processor, wherein said uniquely identified data are correlated to obtain a count of overdue vehicles and early arriving vehicles; and

an incident detection processor.

31. The system of claim 30 wherein said plurality of unique vehicle data readers further comprise:

a plurality of traffic probe readers, each of said plurality of traffic probe readers having an automatic vehicle identification reader; and

a plurality of toll gateways, each of said plurality of toll gateways having an automatic vehicle identification reader.

32. The system of claim 30 further comprising a plurality of roadside toll collection devices coupled to said plurality of toll gateways, said plurality of traffic probe readers, and said traffic management center, such that the volume of data transmitted to said traffic management center is minimized.

33. The system of claim 30 wherein said correlation processor is connected to said traffic management center processor.

34. The system of claim 30 wherein said correlation processor is connected to said roadside toll collection device.

35. The system of claim 30 wherein said incident processor is connected to said traffic management center processor.

36. The system of claim 30 wherein said incident processor is connected to said roadside toll collection device.